

Assessing Laypeople's Attitudes about Weather Forecasts and Forecast Uncertainty Information

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Meeting with NOAA/NWS
Forecast Uncertainty Steering Team

November 1, 2007



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Outline

- Brief overview of NCAR's Societal Impacts Program (SIP)
- Results from recent U.S. household survey
 - People's sources, perceptions, uses and value of weather forecast information
 - People's perception of, interpretation of, and preferences for weather forecast uncertainty information

Origins of SIP

- Very little is currently known about:
 - economic value of current and improved weather information
 - users' sources, perceptions, uses, and value of weather information
 - users' understanding of, use of, and preferences for weather forecast uncertainty information
 - best practices for integrating new weather information into users' environment
- Relevance to NOAA
 - Crucial to fulfilling NOAA mission
 - NOAA has minimal capacity to address these issues
 - Greater demands for NOAA to justify research and activities for budget decisions

Creation of SIP as NOAA-NCAR collaboration

Scope of SIP

- Objective

- Improve the societal gains from weather forecasting by infusing social science and economic research, methods, and capabilities into the planning, execution, and analysis of weather information, applications, and research directions.

- Implementation

- Combination of research, outreach and education, WAS*IS program*, and community support

*** WAS*IS workshops always include communicating uncertainty as a key discussion topic**

Nationwide Survey of U.S. Households

To assess people's views and
attitudes about weather forecasts
and weather forecast uncertainty

Motivation

- Atmosphere is nonlinear and chaotic, so forecasts are inherently uncertain
 - yet, most current weather forecast information is deterministic
 - yet, many users understand that forecasts are imperfect
- Community attention
 - E.g., NRC 2006, AMS 2002, ACUF, NFUSE team, etc.
- Yet it's challenging to effectively communicate uncertainty information

Objectives

- To help the meteorological community in effectively providing weather forecast information, including uncertainty, by better understanding:
 - people's sources, perceptions, uses and value of weather forecast information
 - Also assess how these factors change over time
 - Can inform work on uncertainty
 - people's perception of, interpretation of, and preferences for weather forecast uncertainty information
- This understanding can then be coupled with user-oriented product development efforts


Survey design

- Survey questions developed:
 - based on questions asked in previous survey research
 - to investigate fundamental research questions and issues raised by previous related work
 - to include weather salience (developed by Alan Stewart, psychologist at University of Georgia)
- Pre-tested survey during development and implementation

There is a science to doing surveys!

Survey implementation

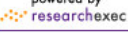
- Implemented survey in November 2006
 - Controlled-access, web-based with sample population provided by survey sampling company
- Analysis based on **N=1465 respondents**

Online Research Survey powered by: 

How often do you get weather forecasts from the sources listed below?

	Rarely or never	Once or more a month	Once a week	Two or more times a week	Once a day	Two or more times a day
Commercial or public radio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Telephone (dial-in) weather information source	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Newspapers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cable TV stations (e.g., CNN, The Weather Channel)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local TV stations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friends, family, co-workers, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cell phone, personal desk assistant (PDA), pager, or other electronic device	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other webpages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
National Weather Service (NWS) webpages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NOAA Weather Radio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

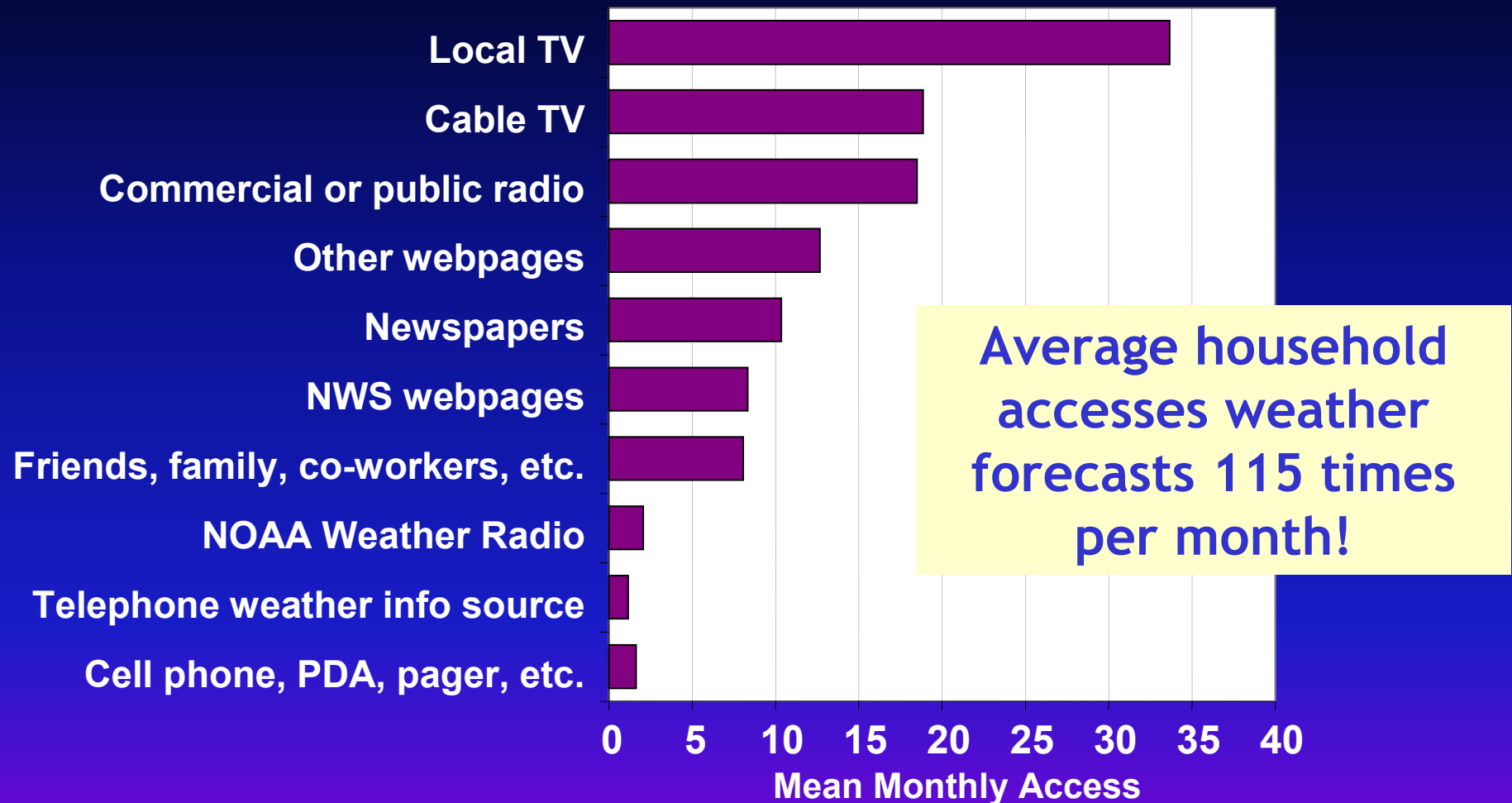
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powered by 

Weather forecast research questions

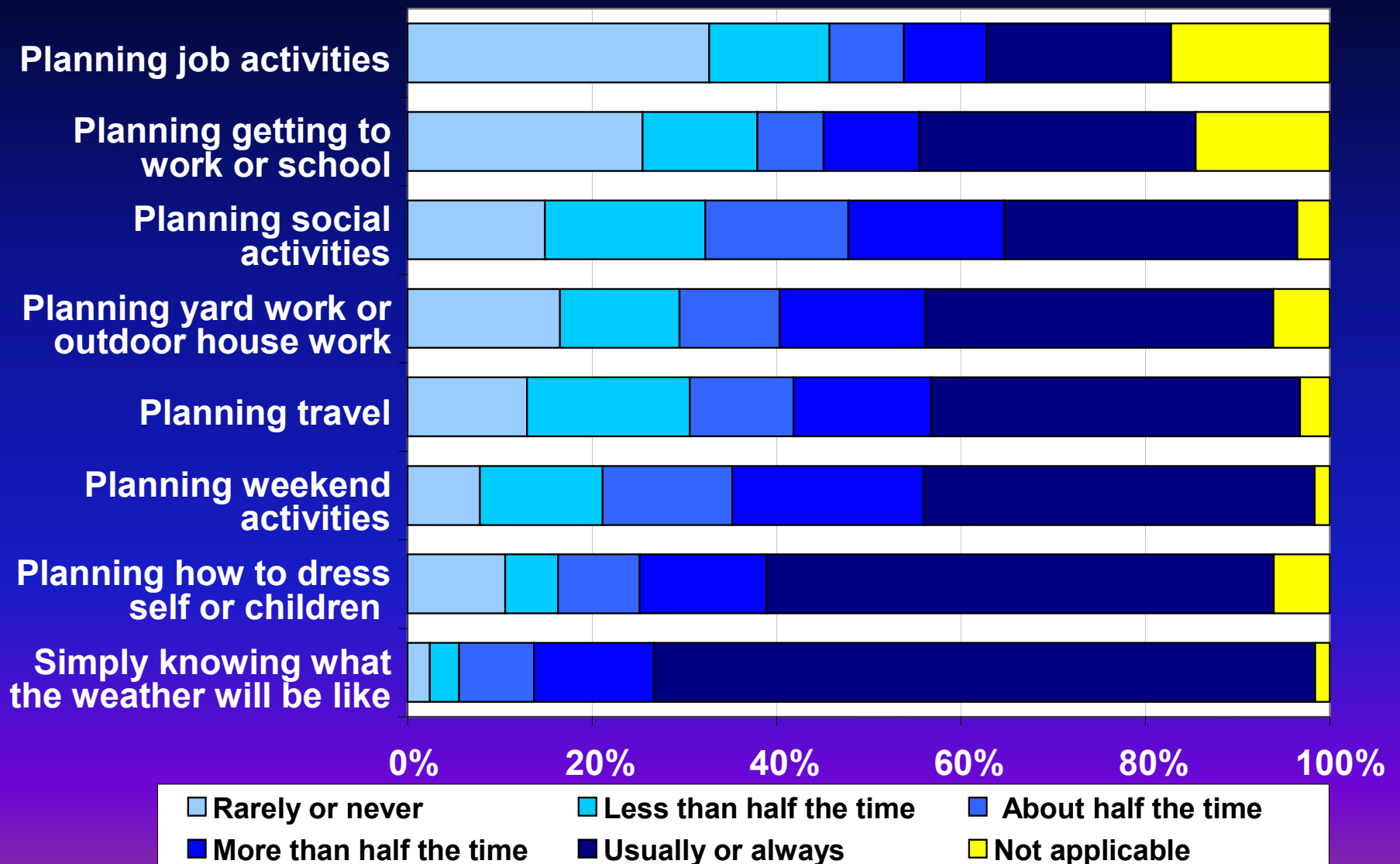
- From where and how often do people get weather forecast information?
- For what locations or regions do people get forecasts?
- What times of day do people get forecasts?
- For what reasons do people get forecasts?
- What weather forecast parameters are important to people?
- What is people's willingness to pay for forecasts?

How often do you get forecasts from the sources listed below?

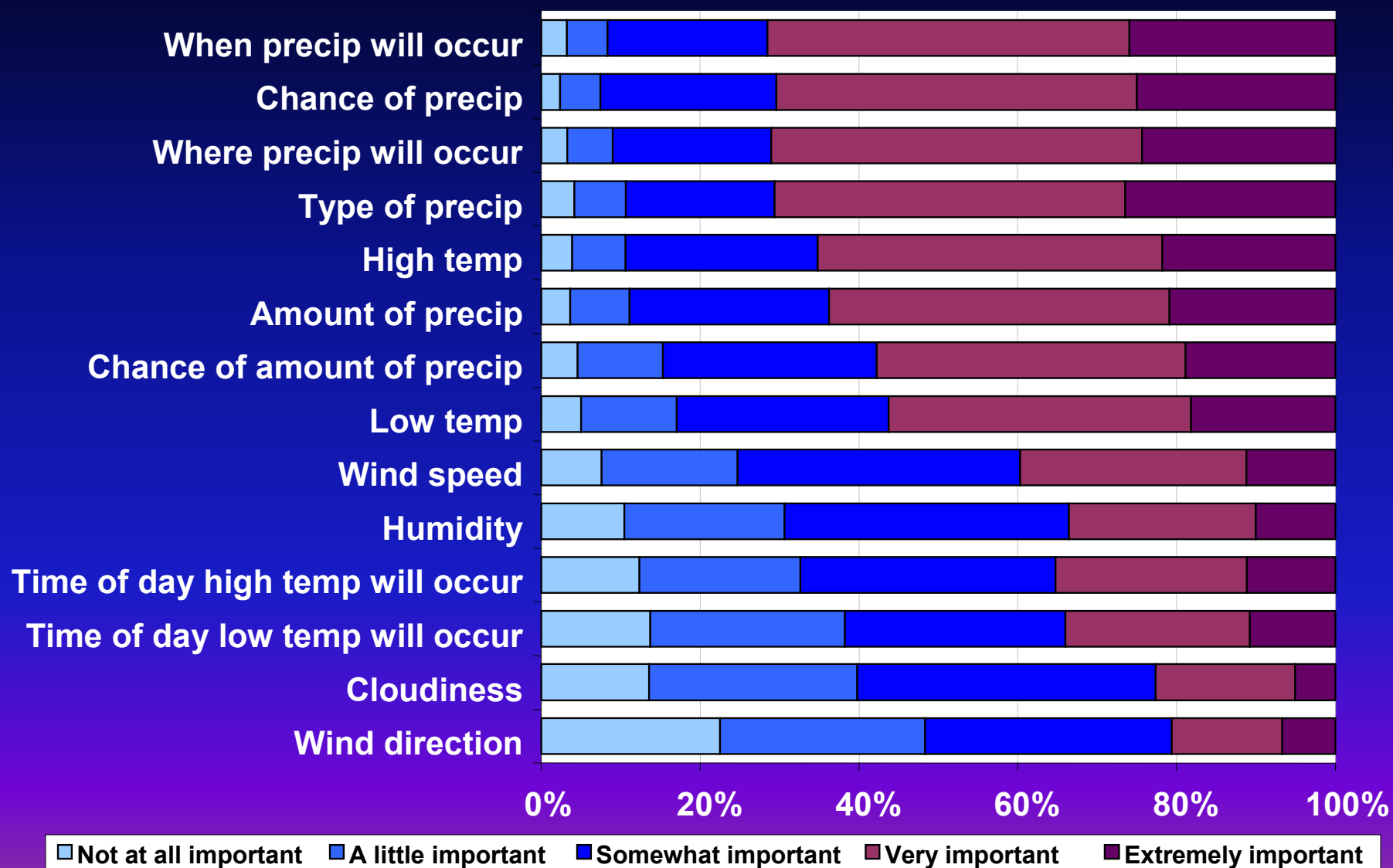


With over 113 million U.S. households, this totals to over 150 Billion forecasts accessed a year!

On average, how often do you use weather forecasts for the activities listed below?

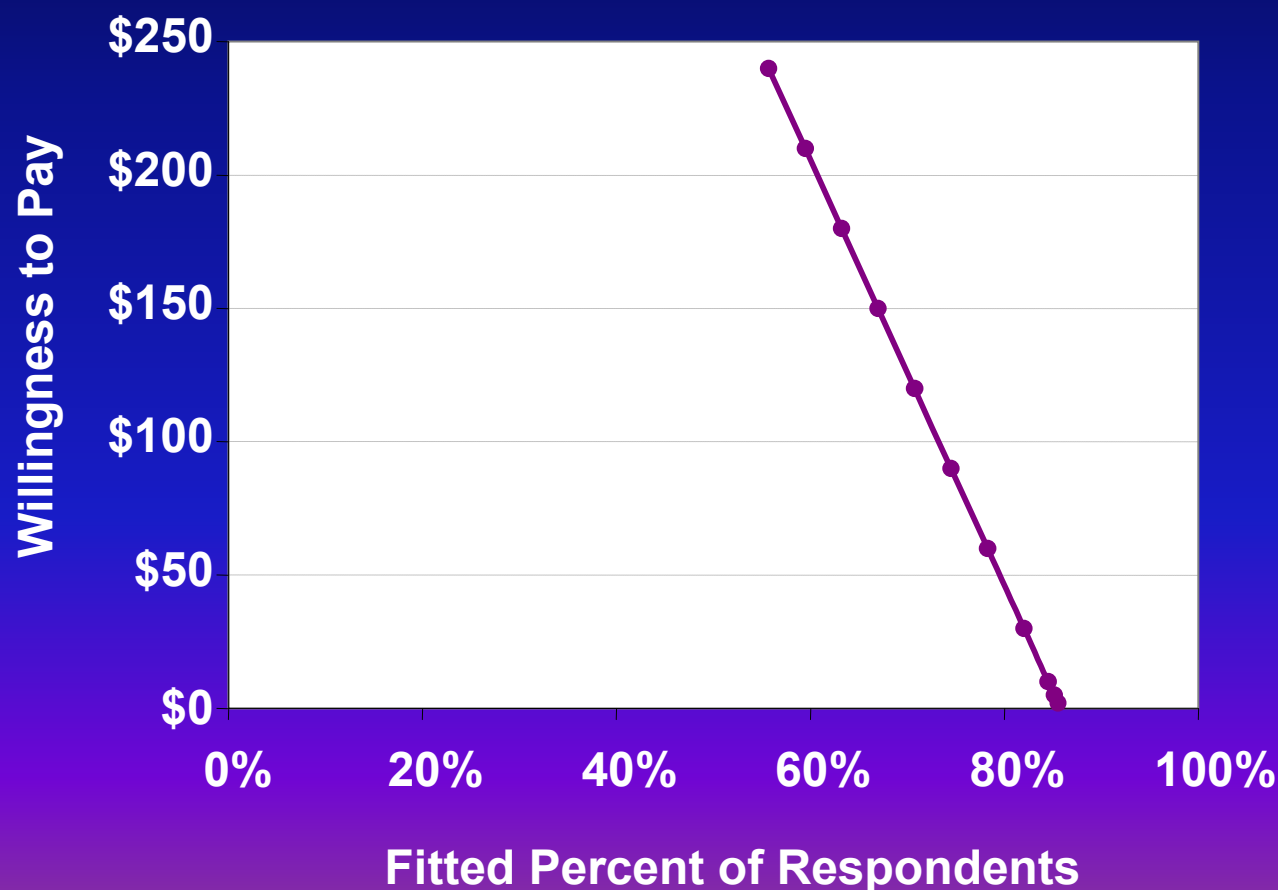


How important is it to you to have the information below as part of a weather forecast?



Do you feel that the NWS services you receive are worth more than, exactly, or less than \$N a year to your household?

- Given values for \$N varied among \$2, \$5, \$10, \$30, \$60, \$90, \$120, \$150, \$180, \$210, \$240



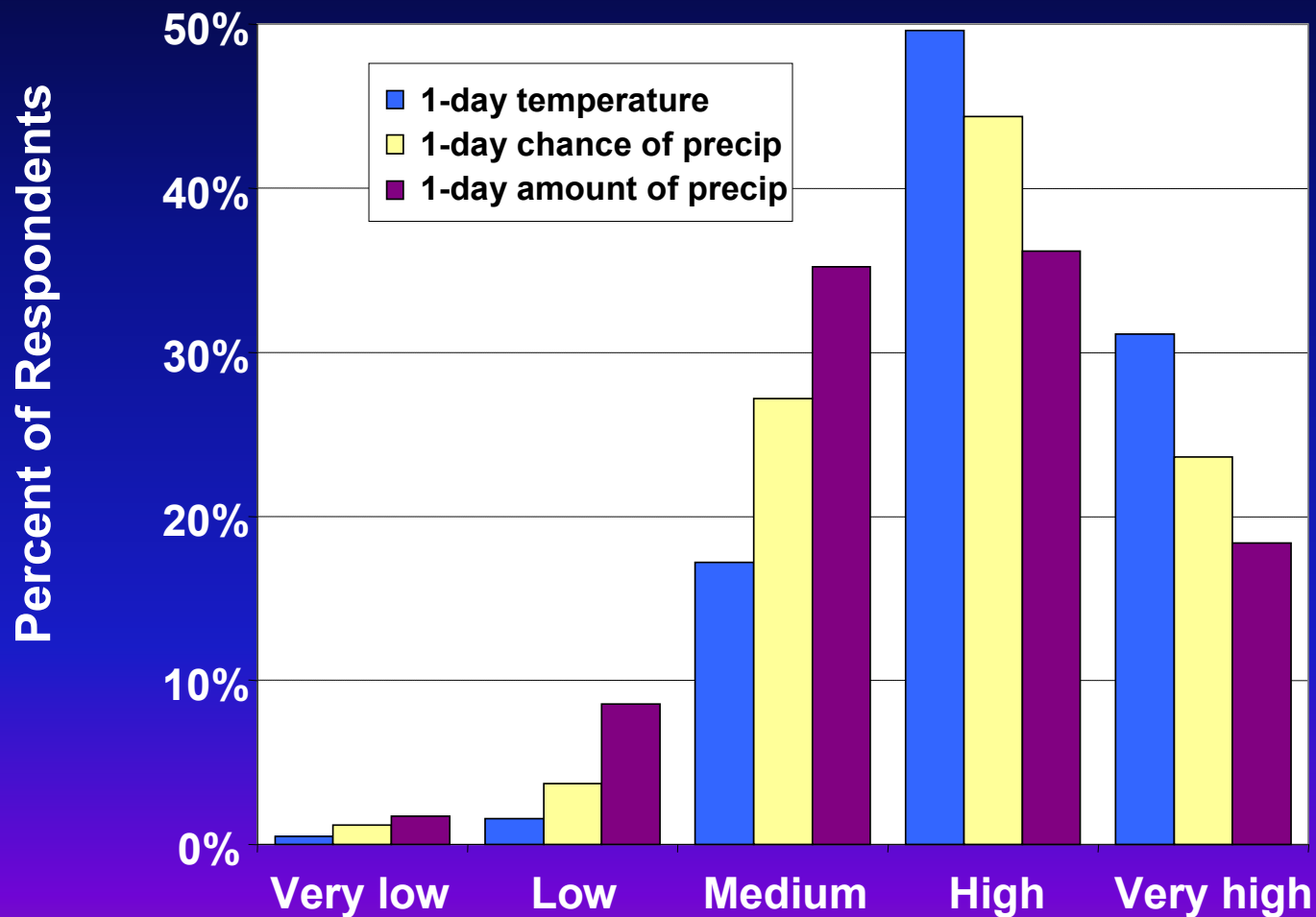
Uncertainty research questions

- How much confidence do people have in different types of weather forecasts?
- Do people infer uncertainty into deterministic forecasts and, if so, how much?
- How do people interpret a type of uncertainty forecast that is already commonly available and familiar: probability of precipitation forecasts?
- To what extent do people prefer to receive deterministic vs. uncertainty-explicit forecasts?
- In what formats do people prefer to receive forecast uncertainty information?

- How much confidence do people have in different types of weather forecasts?
- Do people infer uncertainty into deterministic forecasts and, if so, how much?

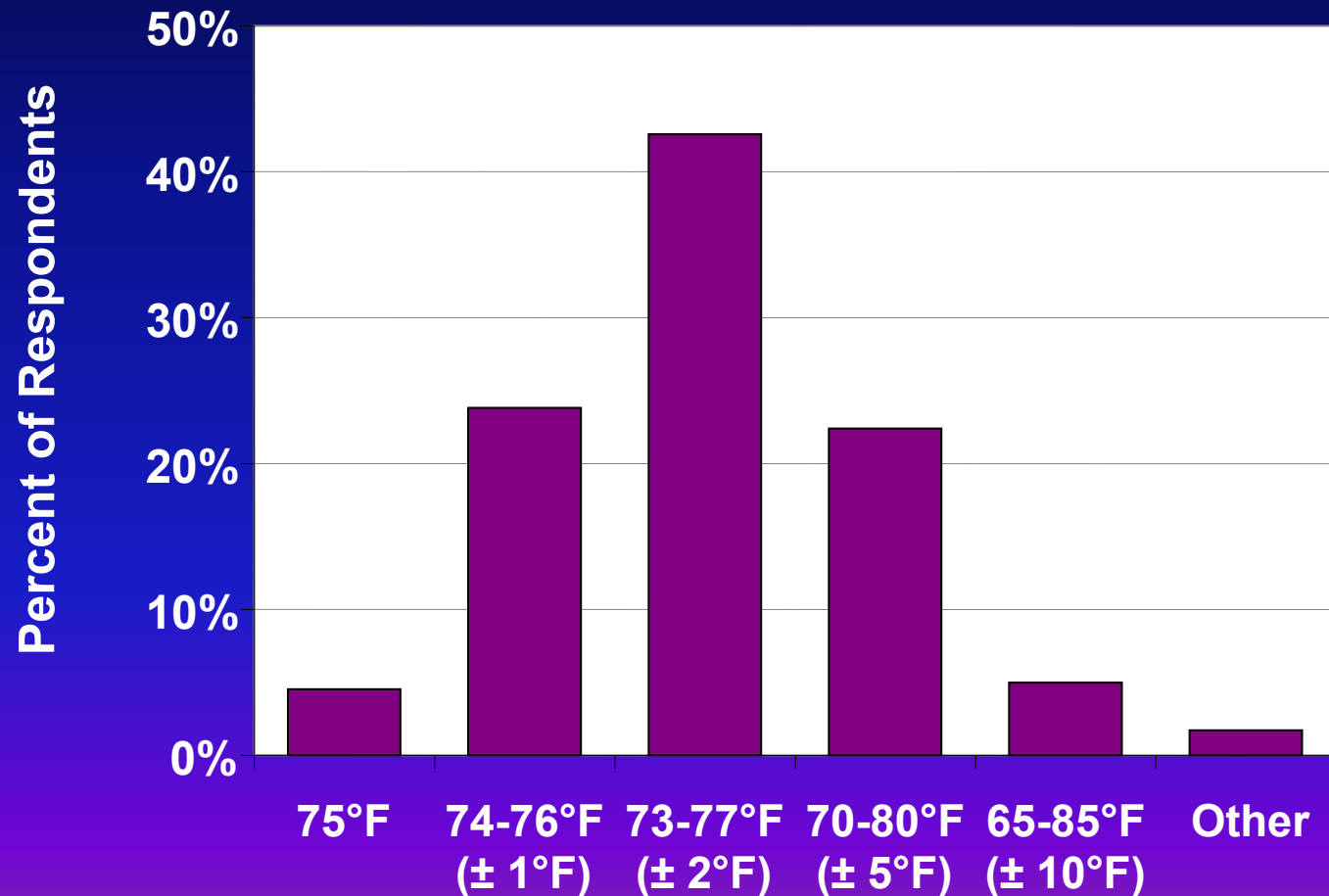
(Perception)

How much confidence do you have in weather forecasts of ...



Suppose the forecast high temperature for tomorrow for your area is 75°F.

What do you think the actual high temperature will be?



- How do people interpret a type of uncertainty forecast that is already commonly available and familiar: probability of precipitation forecasts?

(Interpretation)

Suppose the forecast says, “There is a 60% chance of rain tomorrow.”

What do you think best describes what the forecast means?

Response option (N=1330)	Percent of respondents
It will rain tomorrow in 60% of the region.	16%
It will rain tomorrow for 60% of the time.	10%
It will rain on 60% of the days like tomorrow.*	19%
60% of weather forecasters believe that it will rain tomorrow.	22%
I don't know.	9%
Other (please explain)	24%

*** Technically correct interpretation, according to how PoP forecasts are verified (Gigerenzer et al. 2005)**

Suppose the forecast says, “Rain likely tomorrow.”

What do you think best describes what the forecast means?

Response option (N=1330)	Percent of respondents
It will likely rain over the entire forecast area tomorrow.	17%
It will likely rain throughout the day somewhere in the forecast area tomorrow.	24%
It will likely rain at any one particular point in the forecast area tomorrow.*	29%
Weather forecasters are likely to believe that it will rain tomorrow.	23%
I don't know.	3%
Other (please explain)	3%

*** Technically correct interpretation, according to the NWS definition of PoP forecasts (NWS 2005).**

Open-ended responses re: PoP

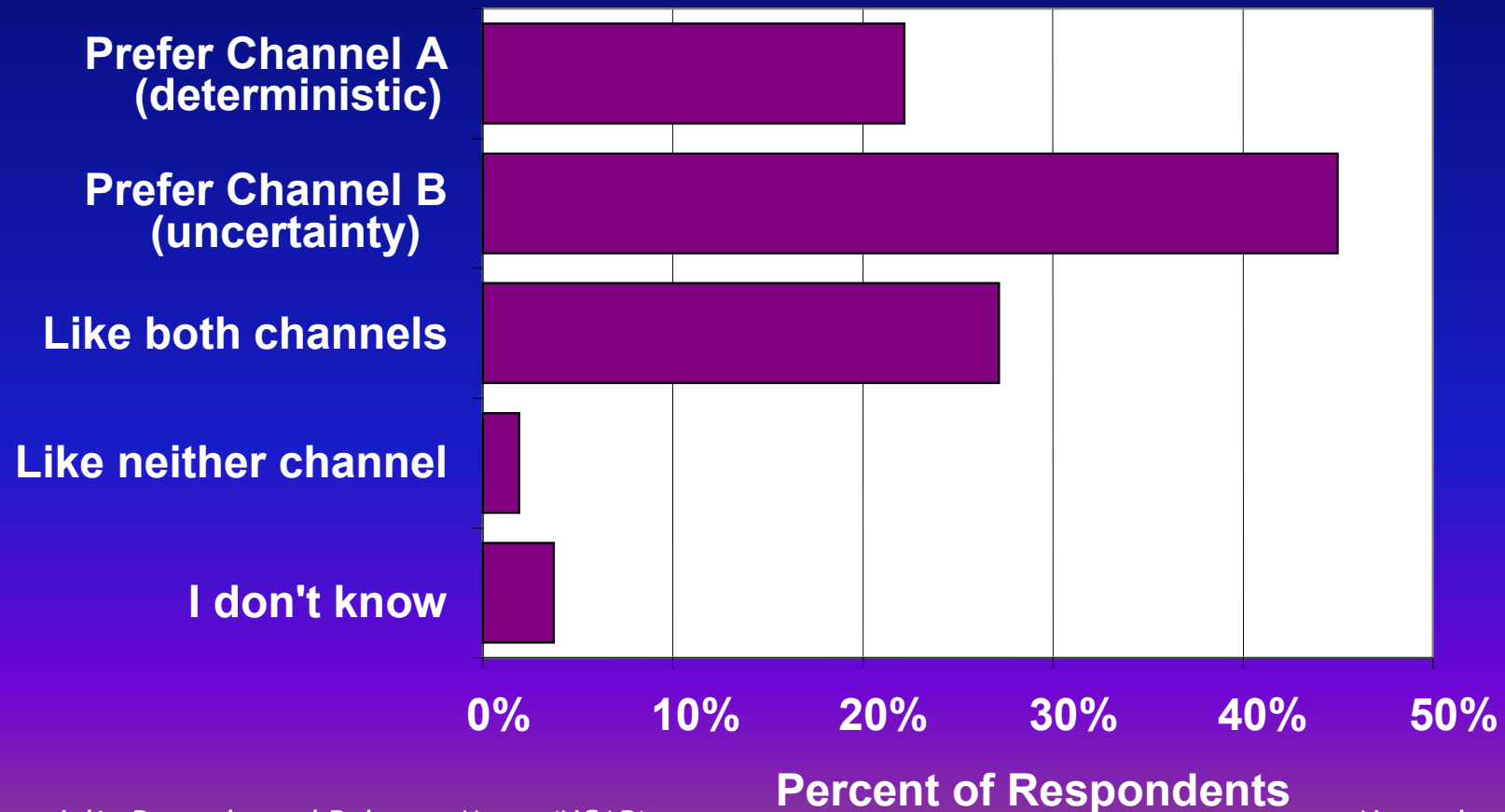
- Interesting insight from the responses to open-ended question and “other” write-in responses
 - Personally experience rain or personal implications for action
- Consistent with other studies, majority of people don't know technically correct definition of PoP, but...
- Asking people to think about PoP from a meteorological perspective may have limited value ... people still have to infer what it means to them

- To what extent do people prefer to receive deterministic vs. uncertainty-explicit forecasts?
- In what formats do people prefer to receive forecast uncertainty information?

(Preferences)

Suppose you are watching the local evening news ...

- The Channel A weather forecaster says the high temperature will be 76°F tomorrow
- The Channel B weather forecaster says the high temperature will be between 74°F and 78°F tomorrow.



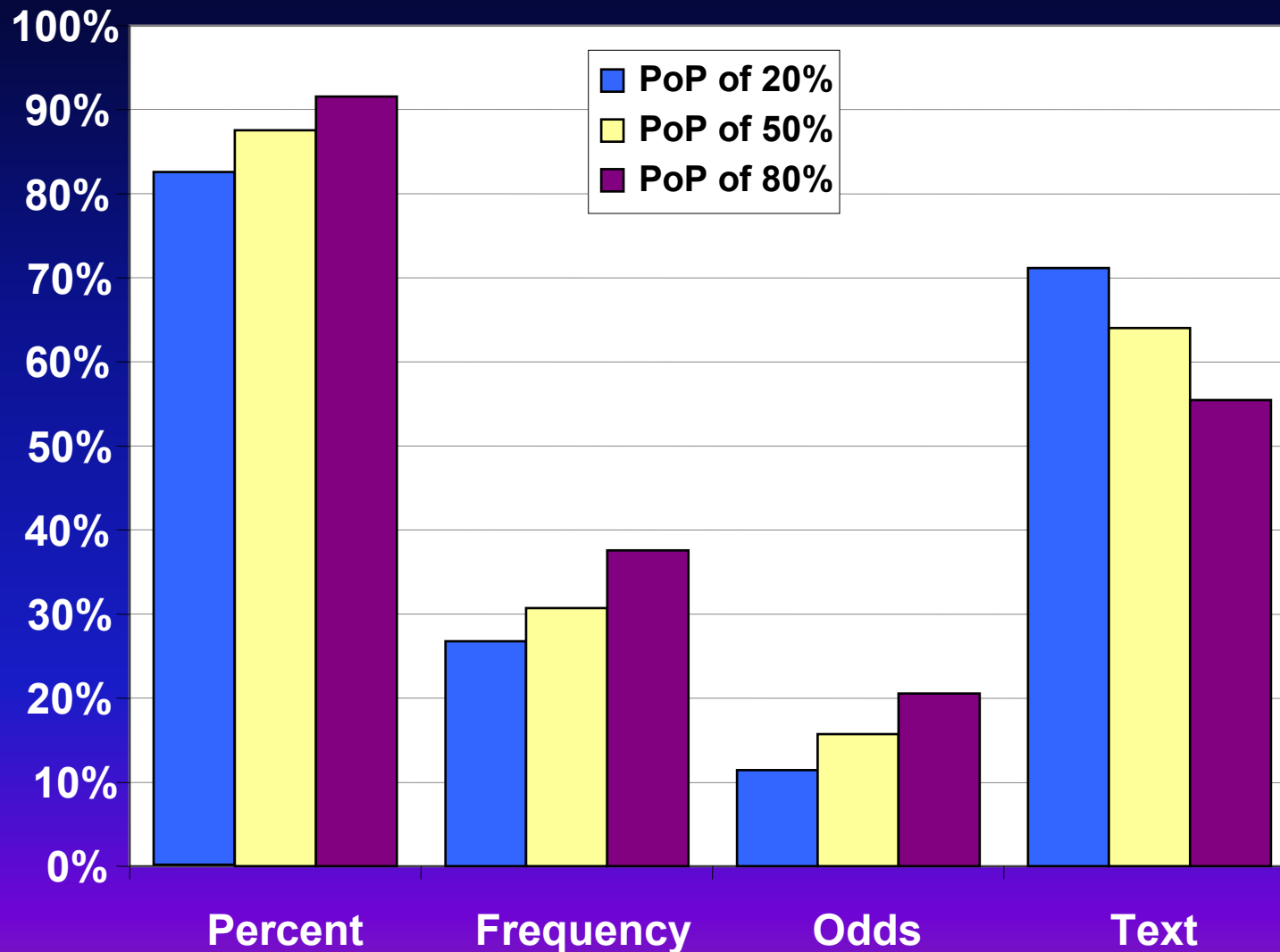
All the choices below are the same as a probability of precipitation of 20%.

Do you like the information given this way?

- Chance of precipitation is 20% → Percent
- There is a 1 in 5 chance of precipitation → Frequency
- The odds are 1 to 4 that it will rain → Odds
- There is a slight chance of rain tomorrow → Text

Asked this question 3 ways --
using PoPs of 20%, 50%, and 80% with
corresponding text descriptions from NWS

Percent of respondents who said “yes”



N = 489, 489, 487

Suppose the high temperature tomorrow will probably be 85°F. A cold front may move through, making the high only 70°F.

Would you like the forecast given this way?

The high temperature tomorrow...

...will be 85°F

...will most likely be 85°F, but it may be 70°F (WITHOUT explanation)

...will most likely be 85°F, but it may be 70°F, because a cold front may move through (WITH explanation)

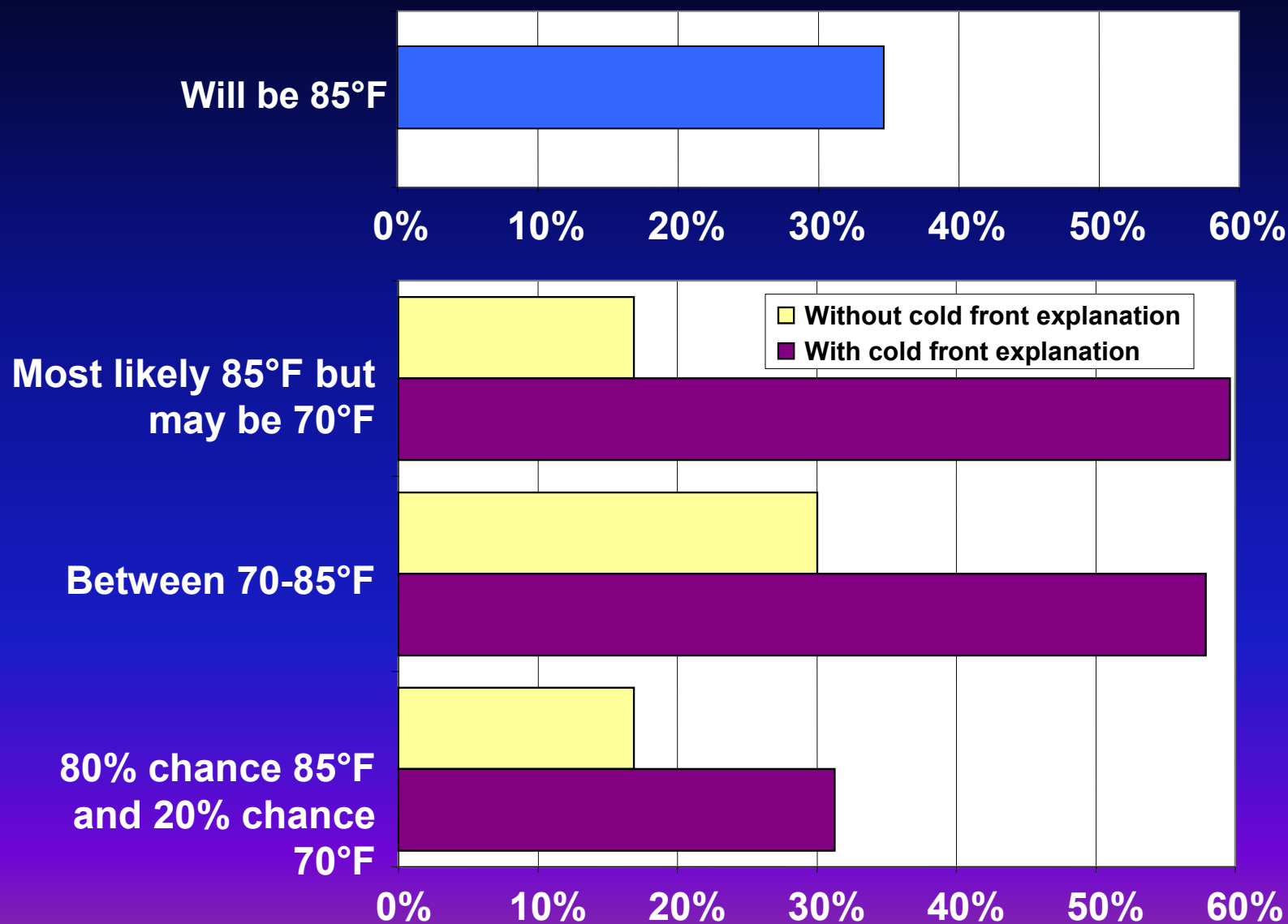
...will be between 70°F and 85°F

...will be between 70°F and 85°F, because a cold front may move through

80% chance it will be 85°F, 20% chance it will be 70°F

80% chance it will be 85°F, 20% chance it will be 70°F, because a cold front may move through

Percent of respondents who said “yes”



To summarize

- Weather forecast views and attitudes, including on uncertainty
 - 150 billion served!
 - Majority of people like uncertainty info and many prefer it
 - People have preferences for how uncertainty information is conveyed
- Dissemination of results
 - Submitted manuscript with uncertainty results to Weather and Forecasting this week
 - Will submit manuscript with sources, uses, perceptions info to BAMS in early 2008

Connecting physical and social science in these ways will help more effectively communicate weather forecast information, including uncertainty!

Future work

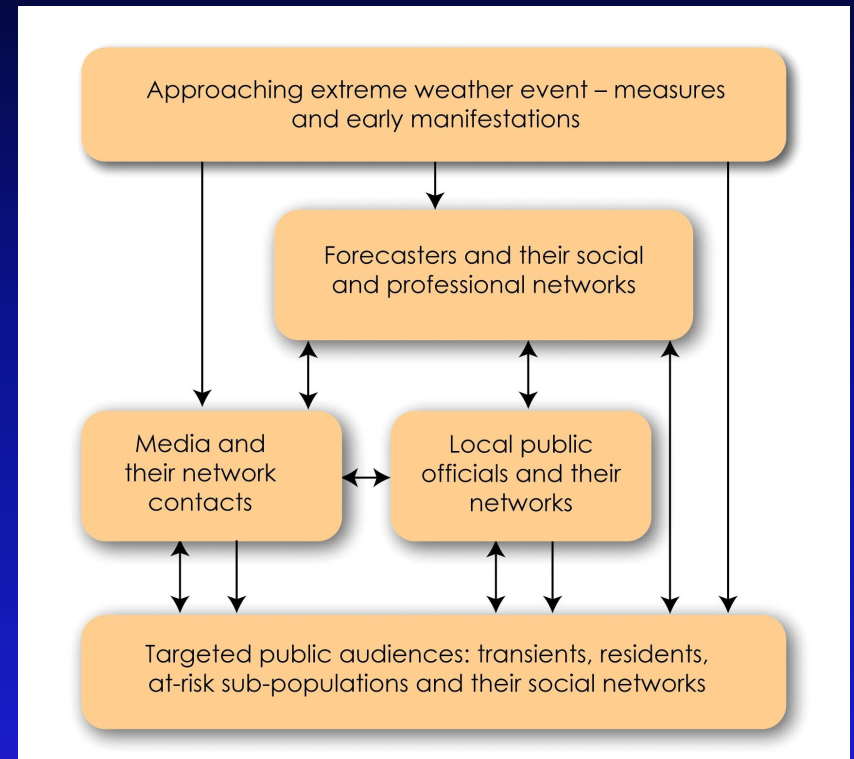
- Future research questions to pursue
 - People's interpretations of and preferences for uncertainty information in other formats (including graphics), in different weather situations, across different media, etc.
 - People's use of different types of uncertainty information
- Grant funded this survey
- Seeking additional funding for future research in this area

Other SIP research including uncertainty

- Warning decisions in extreme weather events

- Interactions among 4 groups (forecasters, public officials, the media, the public)
- Their communication, interpretation, and use of hurricane and flash flood warnings
- Uncertainty challenges

- Hurricane household valuation study
- Hydrometeorological testbed



Requesting your input

- What parts of our work are most useful to the NWS?
- What does the NWS see as the top uncertainty-related research priorities?
- How to transition research findings to improved products / operations?
- Are there funding opportunities we can pursue to continue with our uncertainty-related work?

Societal Impacts Program

... aims to improve societal gains from weather forecasting by infusing social science and economic research, methods, and capabilities into the planning, execution, and analysis of weather information, applications, and research directions

- research
- WAS*IS
- outreach and education
- community support

Thank you!

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